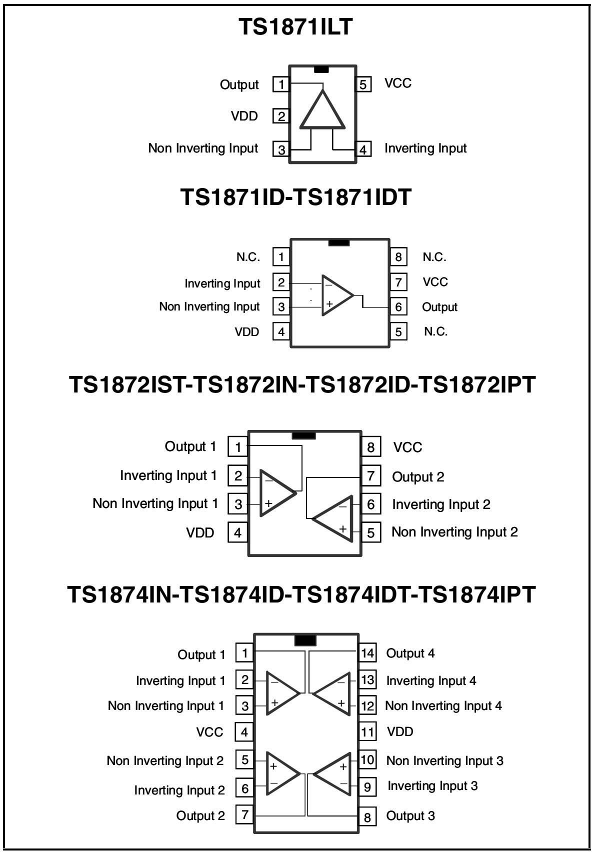
TS1871-TS1872-TS1874

1.8V Input/Output Rail-to-Rail Low Power Operational Amplifiers

- **Operating at V_{CC} = 1.8V to 6V**
- **Rail-to-rail input & output**
- **Extended Vicm (V_{DD} - 0.2V to V_{CC} + 0.2V)**
- **Low supply current (400µA)**
- **Gain bandwidth product (1.6MHz)**
- **High stability**
- **ESD tolerance (2kV)**
- **Latch-up immunity**
- **Available in SOT23-5 micropackage**

Pin Connections (top view)



Description

The TS187x (single, dual & quad) is an operational amplifier family able to operate with voltage as low as 1.8V and features both I/O rail-to-rail.

The common mode input voltage extends 200mV at 25°C beyond the supply voltages while the output voltage swing is within 100mV of each rail with 600 Ohm load resistor. This device consumes typically 400µA per channel while offering 1.6Mhz of gain-bandwidth product. The amplifier provides high output drive capability typically at 65mA-load.

These performances make the TS187X family ideal for sensor interface, battery-supplied and portable applications.

Applications

- **Battery-powered applications (toys)**
- **Portable communication devices (cell phone)**
- **Audio driver (headphone driver)**
- **Laptop/notebook computers**

Order Codes

Part Number	Temperature Range	Package	Packaging	Marking
TS1871ID/IDT/AID/AIDT	-40°C, +125°C	SO	Tube or Tape & Reel	
TS1871ILT/AILT		SOT23-5L	Tape & Reel	K171/K172
TS1872IN/AIN		DIP	Tube	
TS1872ID/IDT/AID/AIDT		SO	Tube or Tape & Reel	
TS1872IPT/AIPT		TSSOP (Thin Shrink Outline Package)	Tape & Reel	
TS1872IST/AIST		mini SO	Tape & Reel	K171/K172
TS1874IN/AIN		DIP	Tube	
TS1874ID/IDT/AID/AIDT		SO	Tube or Tape & Reel	
TS1874IPT/AIPT		TSSOP (Thin Shrink Outline Package)	Tape & Reel	

1 Absolute Maximum Ratings

Table 1: Key parametes and their absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage [1]	7	V
V_{id}	Differential Input Voltage [2]	±1	V
V_i	Input Voltage	V_{DD}-0.3 to V_{CC} +0.3	V
T_{stg}	Storage Temperature	-65 to +150	°C
T_j	Maximum Junction Temperature	150	°C
R_{thja}	Thermal Resistance Junction to Ambient[3] SOT23-5 SO8 SO14 TSSOP8 TSSOP14 miniSO8	 250 125 103 120 100 190	°C/W
ESD	HBM: Human Body Model[4]	2	kV
	MM: Machine Model[5]	200	V
	CDM: Charged Device Model	1.5	kV
	Latch-up Immunity	200	mA
	Lead Temperature (soldering, 10sec)	250	°C
	Output Short Circuit Duration	see note[6]	

1) All voltages values, except differential voltage are with respect to network terminal.

2) Differential voltages are the non-inverting input terminal with respect to the inverting input terminal. If Vid > ±1V, the maximum input current must not exceed ±1mA. In this case (Vid > ±1V) an input serie resistor must be added to limit input current.

3) Short-circuits can cause excessive heating. Destructive dissipation can result from simultaneous short-circuit on all amplifiers

4) Human body model, 100pF discharged through a 1.5kΩ resistor into pin of device.

5) Machine model ESD, a 200pF cap is charged to the specified voltage, then discharged directly into the IC with no external series resistor (internal resistor < 5Ω), into pin to pin of device.

6) Short-circuits from the output to V_{cc} can cause excessive heating. The maximum output current is approximately 80mA, independent of the magnitude of V_{cc}. Destructive dissipation can result from simultaneous short-circuits on all amplifiers.

Table 2: Operating conditions

Symbol	Parameter	Value	Unit
VCC	Supply Voltage	1.8 to 6	V
Vicm	Common Mode Input Voltage Range [1]	V_{DD} - 0.2 to V_{CC} + 0.2	V
Vicm	Common Mode Input Voltage Range [2]	V_{DD} to V_{CC}	V
T_{oper}	Operating Free Air Temperature Range	-40 to + 125	°C

1) At 25°C, for $1.8 \leq V_{CC} \leq 6V$, V_{icm} is extended to V_{DD} - 0.2V, V_{CC} + 0.2V.

2) In full temperature range, both Rails can be reached when V_{CC} does not exceed 5.5V.

2 Electrical Characteristics

Table 3: V_{CC} = +1.8V, V_{DD} = 0V, R_L, C_L connected to V_{CC}/2, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $V_{icm} = V_{out} = V_{CC}/2$ TS1871/2/4 TS1871A/2A/4A		0.1	3 1	mV
ΔV_{io}	Input Offset Voltage Drift		2		µV/°C
I_{io}	Input Offset Current [1] $V_{icm} = V_{out} = V_{CC}/2$		3	30	nA
I_{ib}	Input Bias Current [1)] $V_{icm} = V_{out} = V_{CC}/2$		40	125	nA
CMR	Common Mode Rejection Ratio $0 \leq V_{icm} \leq V_{CC}$, $V_{out} = V_{CC}/2$	55	77		dB
SVR	Supply Voltage Rejection Ratio	70	80		dB
A_{vd}	Large Signal Voltage Gain V_{out} = 0.5V to 1.3V R_L = 2kΩ R_L = 600Ω	77 70	92 85		dB
V_{OH}	High Level Output Voltage V_{id} = 100mV R_L = 2kΩ R_L = 600Ω	1.65 1.62	1.77 1.74		V
V_{OL}	Low Level Output Voltage V_{id} = -100mV R_L = 2kΩ R_L = 600Ω		88 115	100 150	mV
I_o	Output Source Current V_{ID} = 100mV, $V_O = V_{DD}$ Output Sink Current V_{ID} = -100mV, $V_O = V_{CC}$	20 20	65 65		mA
I_{CC}	Supply Current (per amplifier), Vout = Vcc/2 A_{VCL} = 1, no load		400	560	µA
GBP	Gain Bandwidth Product R_L = 10kΩ, C_L = 100pF, f = 100kHz	0.9	1.6		MHz
SR	Slew Rate R_L = 10kΩ, C_L = 100pF, AV = 1	0.38	0.54		V/µs
ϕm	Phase Margin C_L = 100pF		53		Degrees
en	Input Voltage Noise		27		nV/√Hz
THD	Total Harmonic Distortion		0.01		%

1) Maximum values including unavoidable inaccuracies of the industrial test.

Table 4: V_{CC} = +3V, V_{DD} = 0V, R_L, C_L connected to V_{CC}/2, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $V_{icm} = V_{out} = V_{CC}/2$ TS1871/2/4 TS1871A/2A/4A		0.1	3 1	mV
ΔV_{io}	Input Offset Voltage Drift		2		µV/°C
I_{io}	Input Offset Current 1 $V_{icm} = V_{out} = V_{CC}/2$		3	30	nA
I_{ib}	Input Bias Current 1) $V_{icm} = V_{out} = V_{CC}/2$		4	125	nA
CMR	Common Mode Rejection Ratio $0 \leq V_{icm} \leq V_{CC}$, $V_{out} = V_{CC}/2$	60	80		dB
SVR	Supply Voltage Rejection Ratio	70	85		dB
A_{vd}	Large Signal Voltage Gain V_{out} = 0.5V to 2.5V R_L = 2kΩ R_L = 600Ω	80 74	92 95		dB
V_{OH}	High Level Output Voltage V_{id} = 100mV R_L = 2kΩ R_L = 600Ω	2.82 2.80	2.95 2.95		V
V_{OL}	Low Level Output Voltage V_{id} = -100mV R_L = 2kΩ R_L = 600Ω		88 115	L120 160	mV
I_o	Output Source Current V_{ID} = 100mV, $V_O = V_{DD}$ Output Sink Current V_{ID} = -100mV, $V_O = V_{CC}$	20 20	80 80		mA
I_{CC}	Supply Current (per amplifier), Vout = Vcc/2 A_{VCL} = 1, no load		450	650	µA
GBP	Gain Bandwidth Product R_L = 10kΩ, C_L = 100pF, f = 100kHz	1	1.7		MHz
SR	Slew Rate R_L = 10kΩ, C_L = 100pF, AV = 1	0.42	0.6		V/µs
φm	Phase Margin C_L = 100pF		53		Degrees
en	Input Voltage Noise		27		nV/√Hz
THD	Total Harmonic Distortion		0.01		%

1) Maximum values including unavoidable inaccuracies of the industrial test.

Table 5: V_{CC} = +5V, V_{DD} = 0V, C_L & R_L connected to V_{CC}/2, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $V_{icm} = V_{out} = V_{CC}/2$ TS1871/2/4 TS1871A/2A/4A		0.1	3 1	mV
ΔV_{io}	Input Offset Voltage Drift		2		µV/°C
I_{io}	Input Offset Current [1] $V_{icm} = V_{out} = V_{CC}/2$		3	30	nA
I_{ib}	Input Bias Current [1)] $V_{icm} = V_{out} = V_{CC}/2$		70	130	nA
CMR	Common Mode Rejection Ratio $0 \le V_{icm} \le V_{CC}$, V_{out} different of $V_{CC}/2$	65	85		dB
SVR	Supply Voltage Rejection Ratio	70	90		dB
A_{vd}	Large Signal Voltage Gain V_{out} = 1V to 4V $R_L = 2k\Omega$ $R_L = 600\Omega$	83 77	92 85		dB
V_{OH}	High Level Output Voltage V_{id} = 100mV $R_L = 2k\Omega$ $R_L = 600\Omega$	4.80 4.75	4.95 4.90		V
V_{OL}	Low Level Output Voltage V_{id} = -100mV $R_L = 2k\Omega$ $R_L = 600\Omega$		88 115	130 188	mV
I_o	Output Source Current V_{ID} = 100mV, $V_O = V_{DD}$ Output Sink Current V_{ID} = -100mV, $V_O = V_{CC}$	20 20	80 80		mA
I_{CC}	Supply Current (per amplifier), Vout = Vcc/2 A_{VCL} = 1, no load		500	835	µA
GBP	Gain Bandwidth Product $R_L = 10k\Omega$, C_L = 100pF, f = 100kHz	1	1.8		MHz
SR	Slew Rate $R_L = 10k\Omega$, C_L = 100pF, AV = 1	0.42	0.6		V/µs
ϕm	Phase Margin C_L = 100pF		55		Degrees
en	Input Voltage Noise		27		nV/√Hz
THD	Total Harmonic Distortion		0.01		%

1) Maximum values including unavoidable inaccuracies of the industrial test.

Figure 1 :

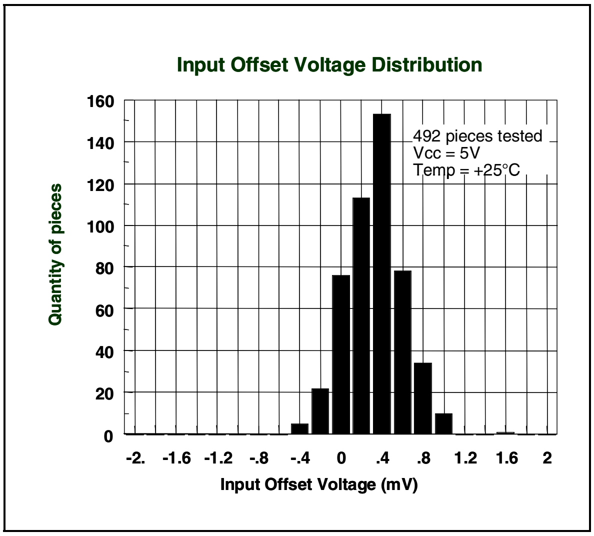


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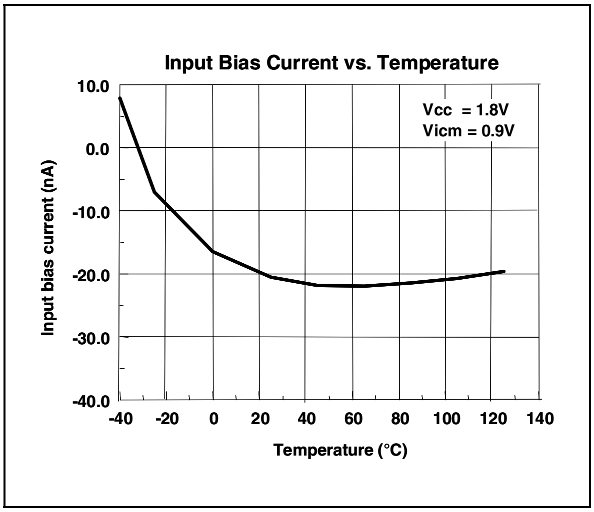


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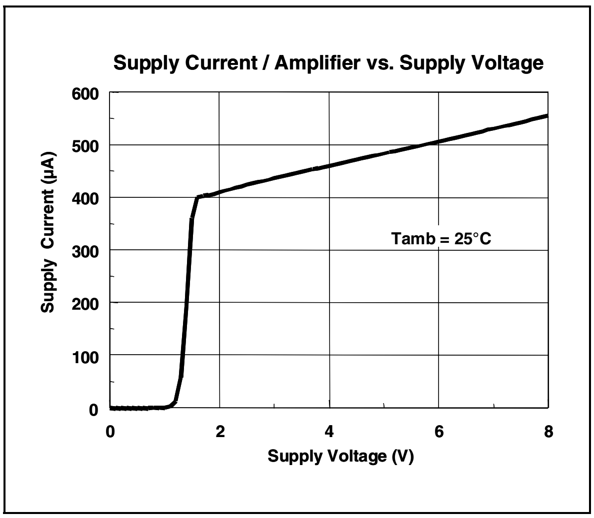


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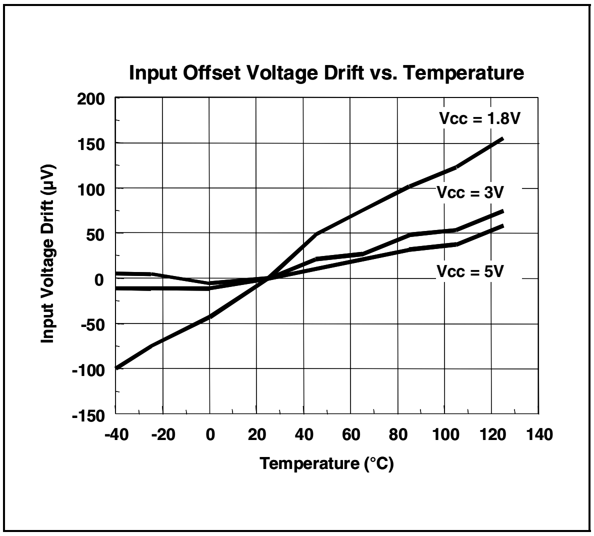


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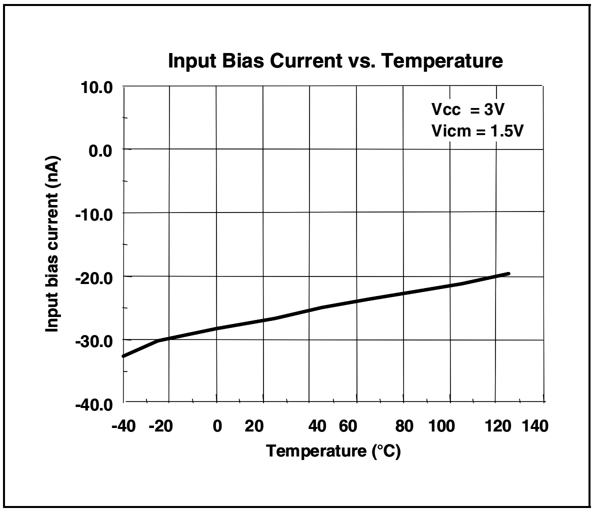


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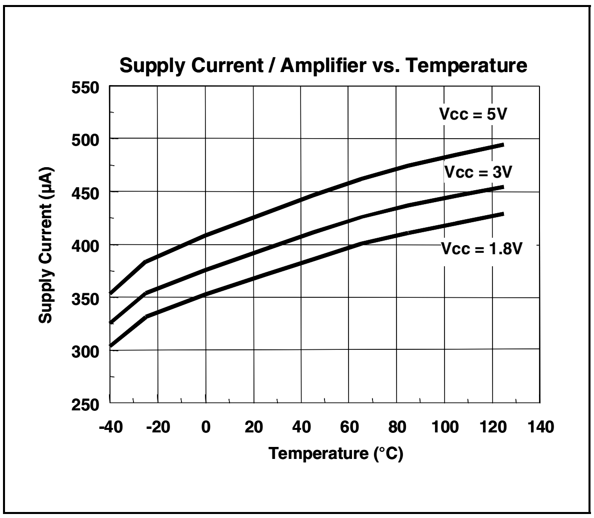


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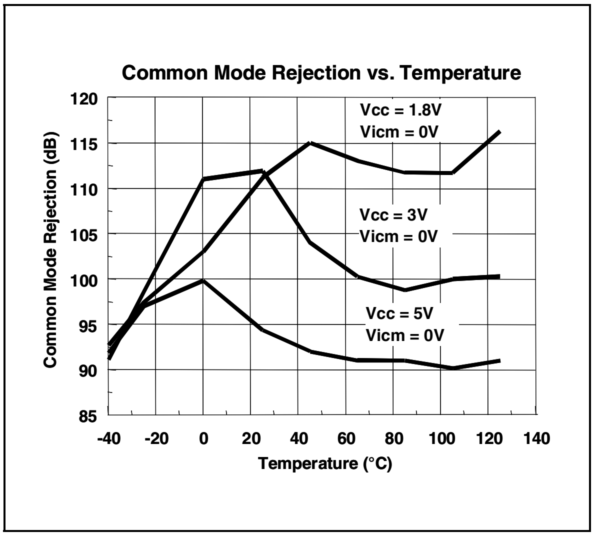


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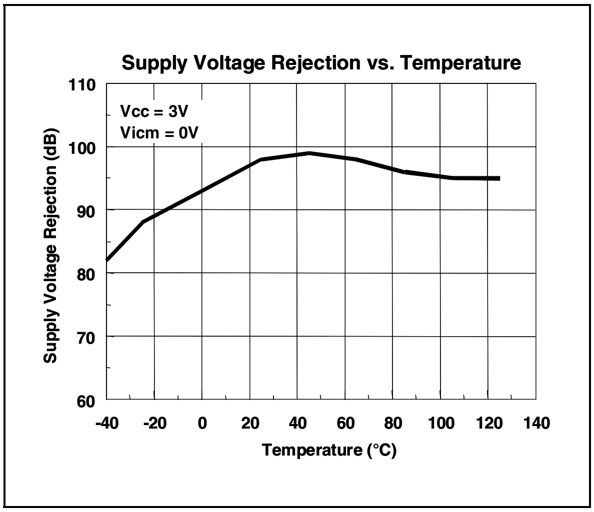


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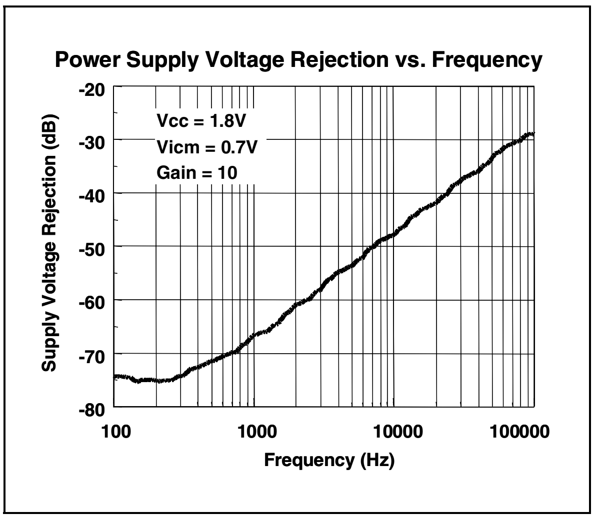


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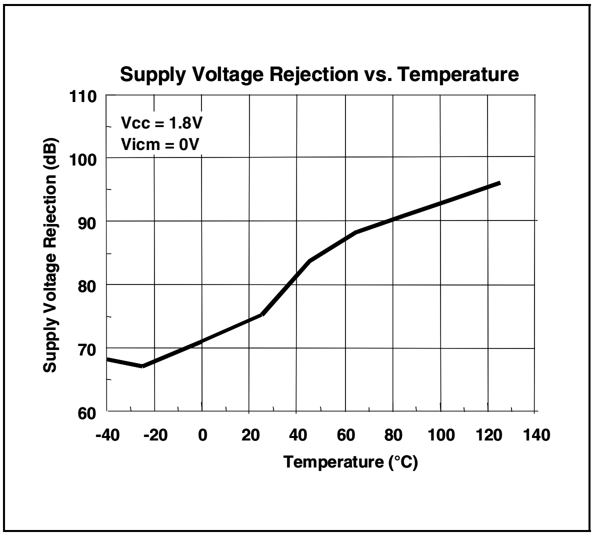


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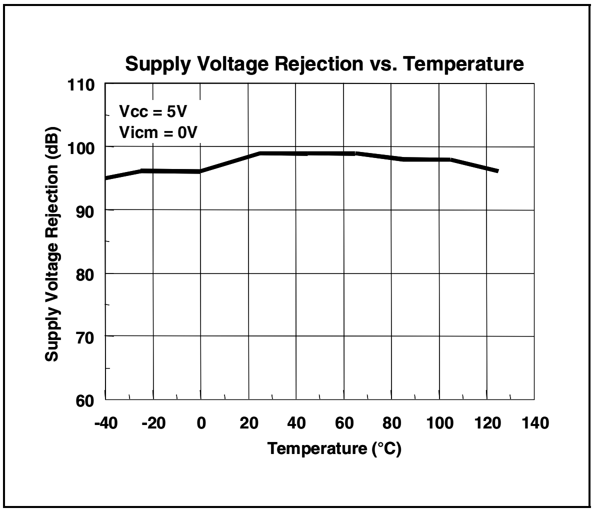


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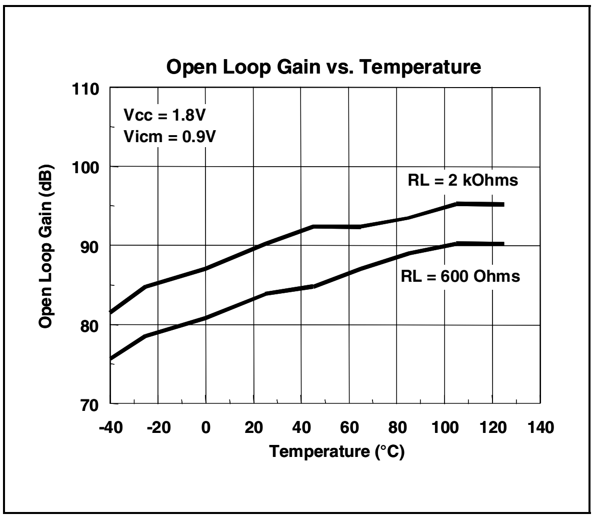


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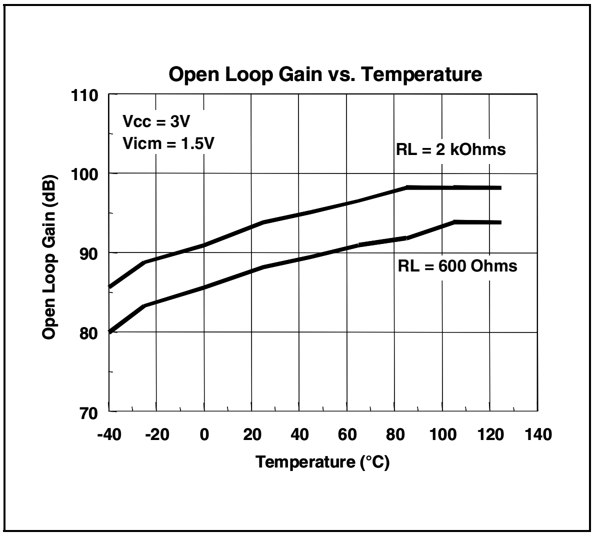


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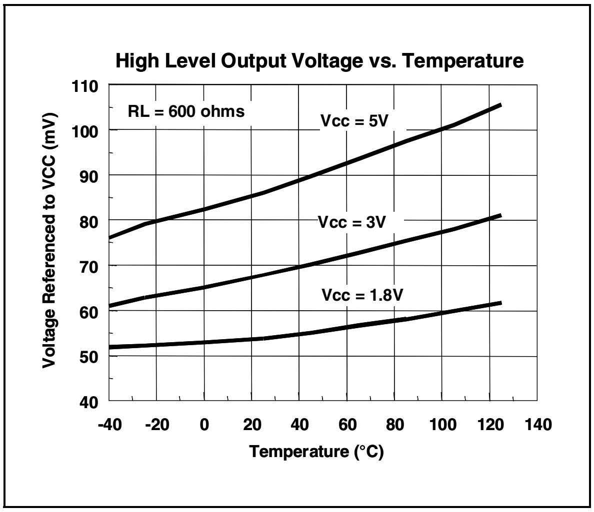


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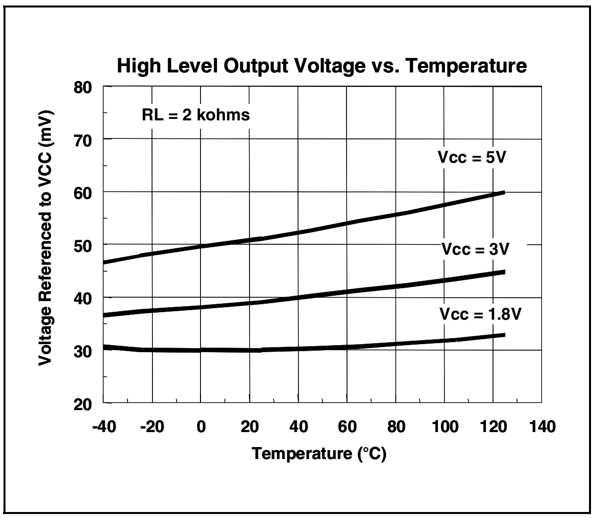


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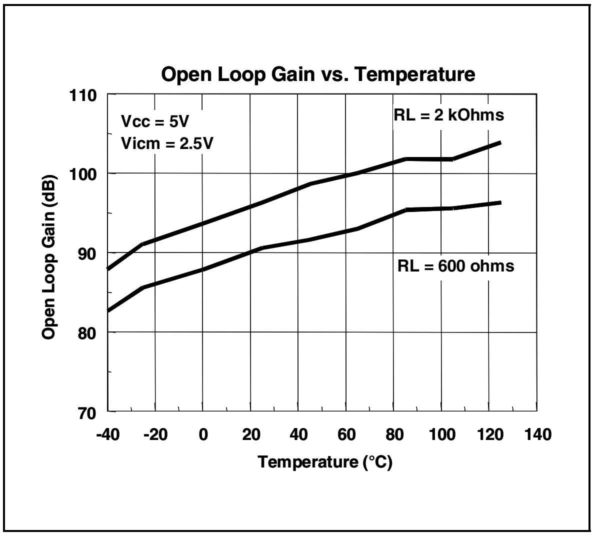


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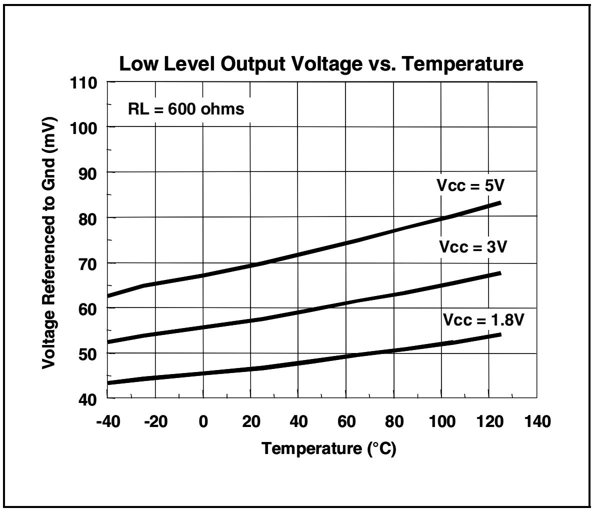


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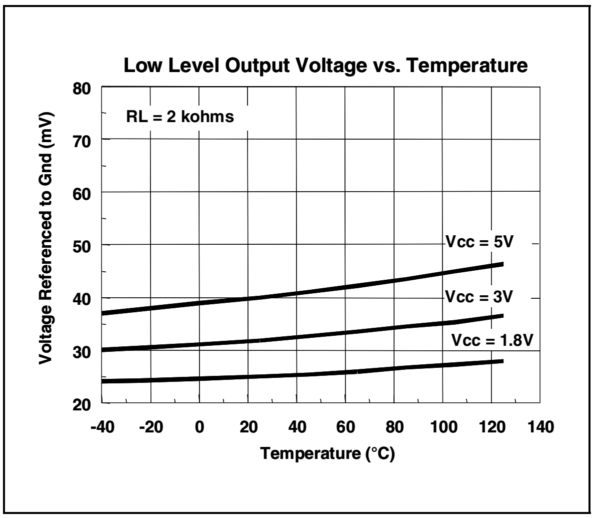


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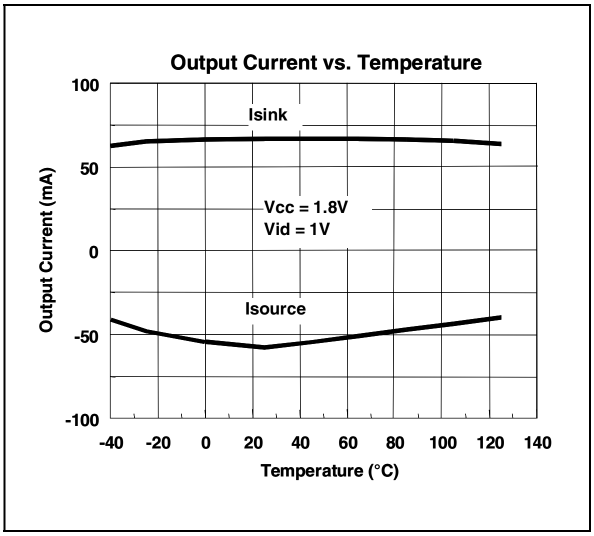


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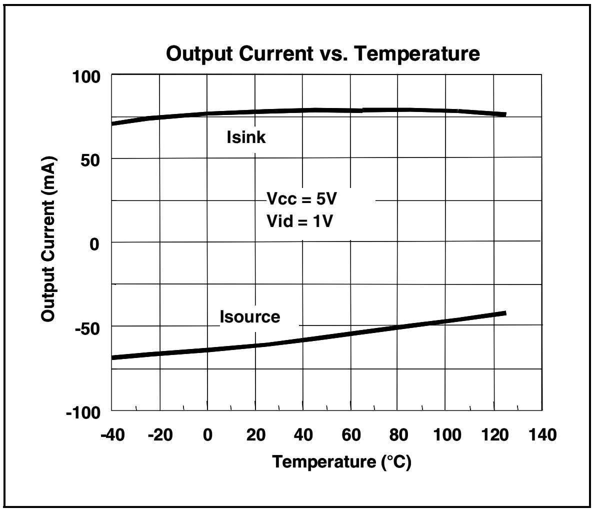


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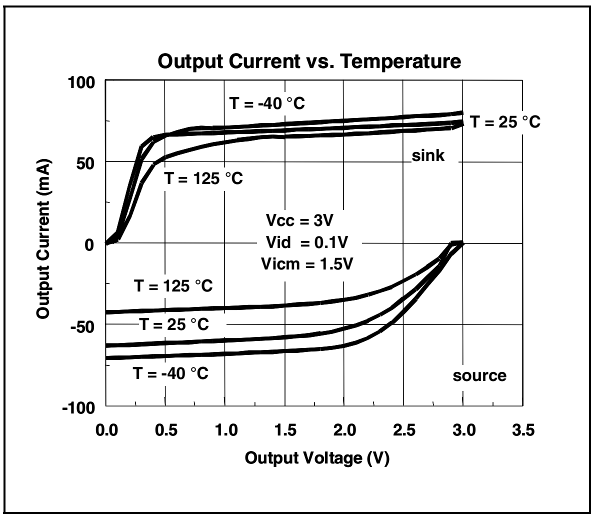


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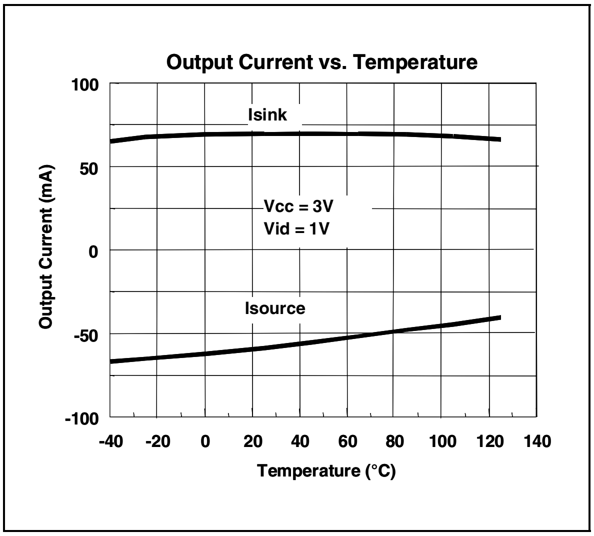


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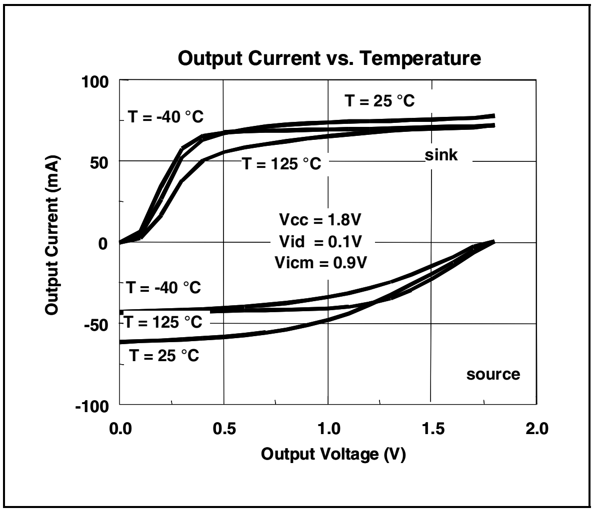


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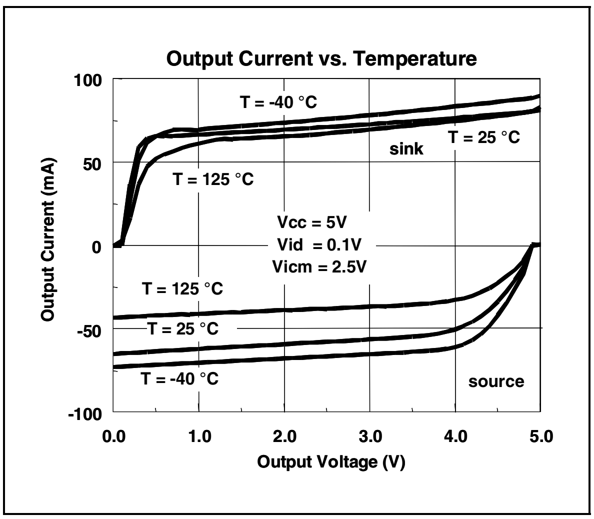


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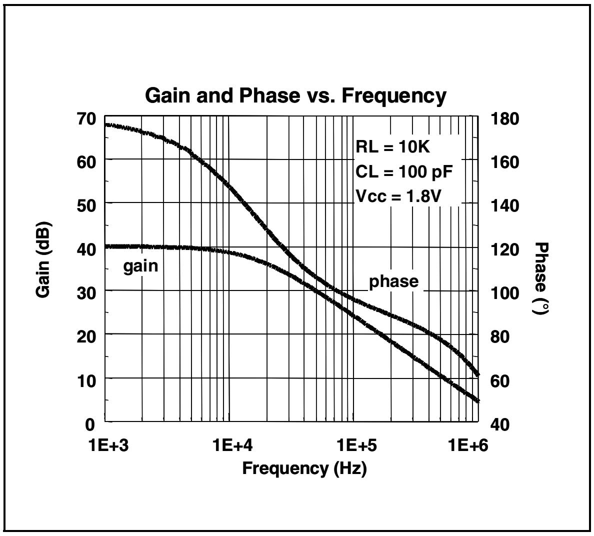


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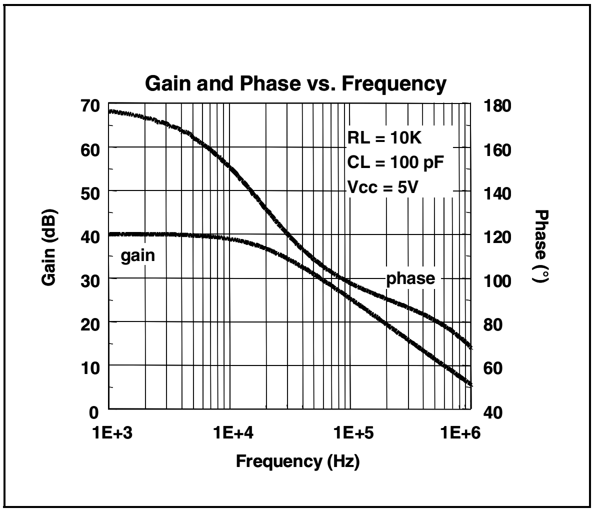


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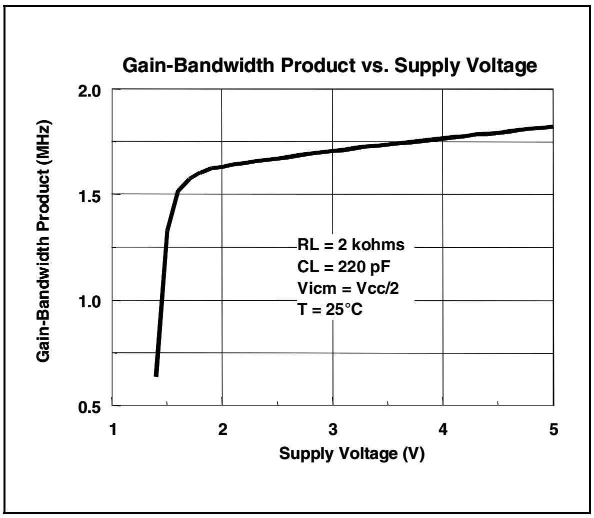


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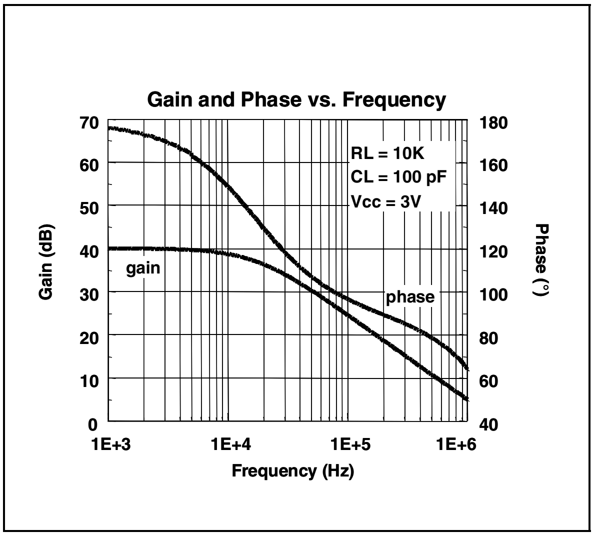


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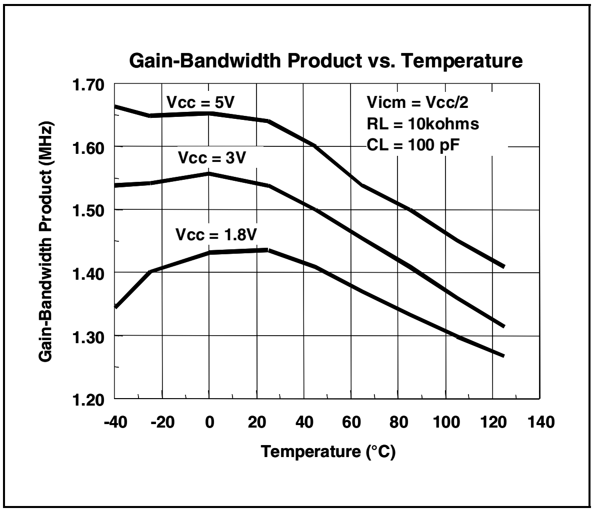


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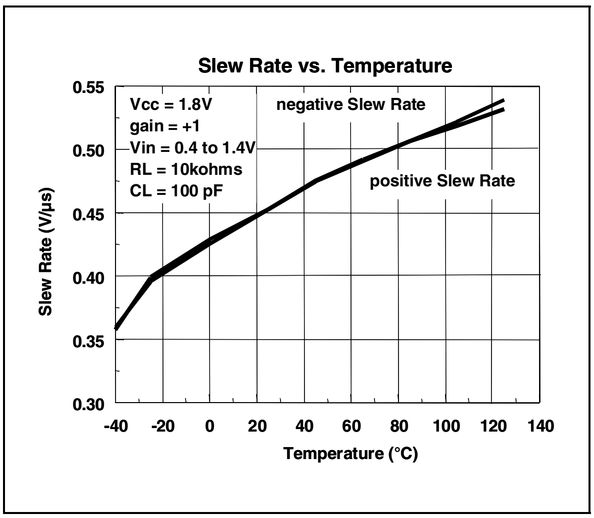


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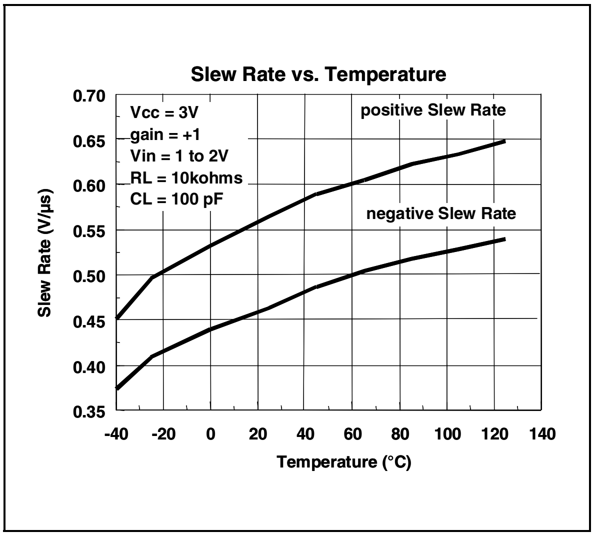


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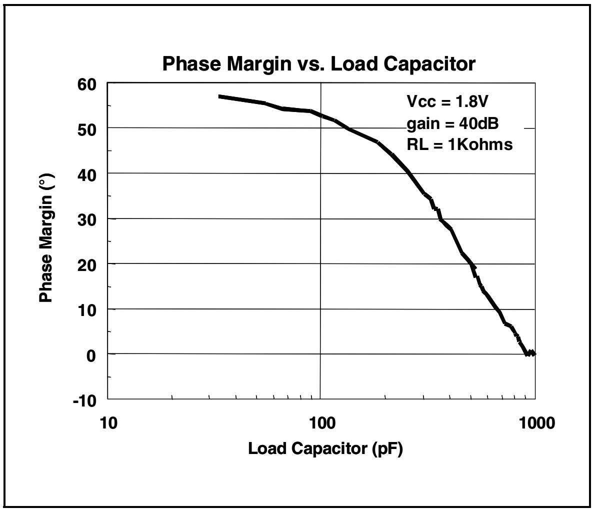


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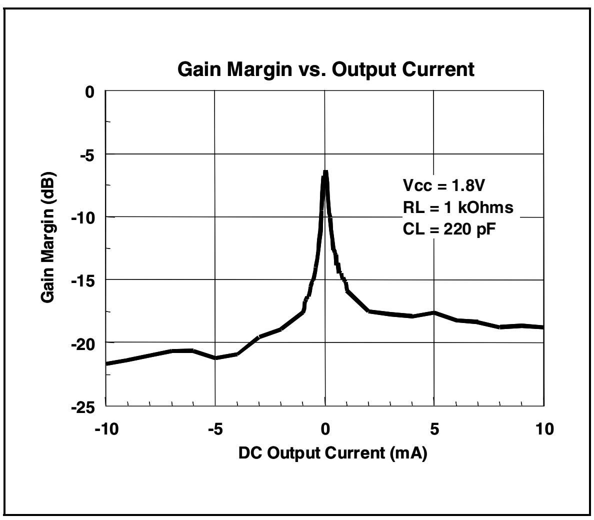


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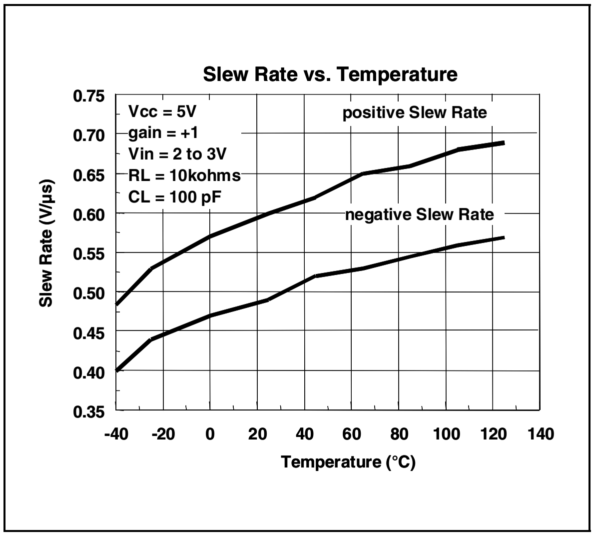


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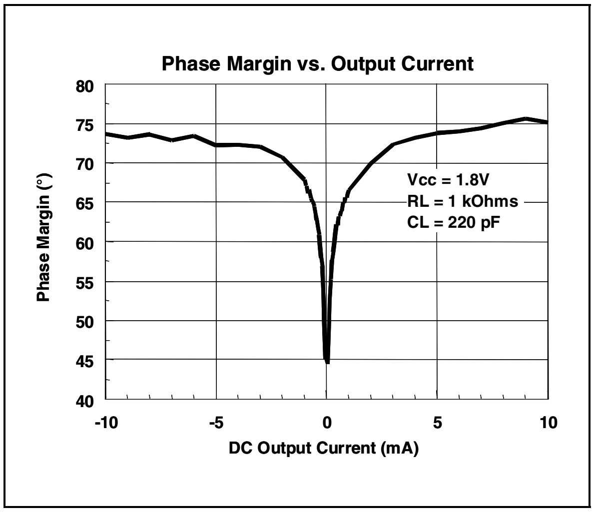


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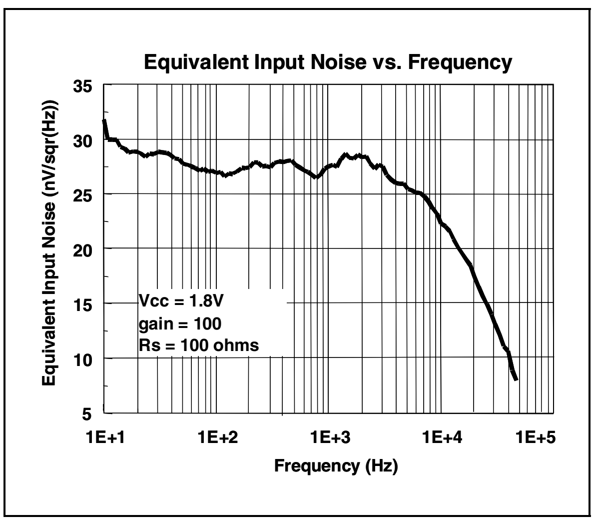


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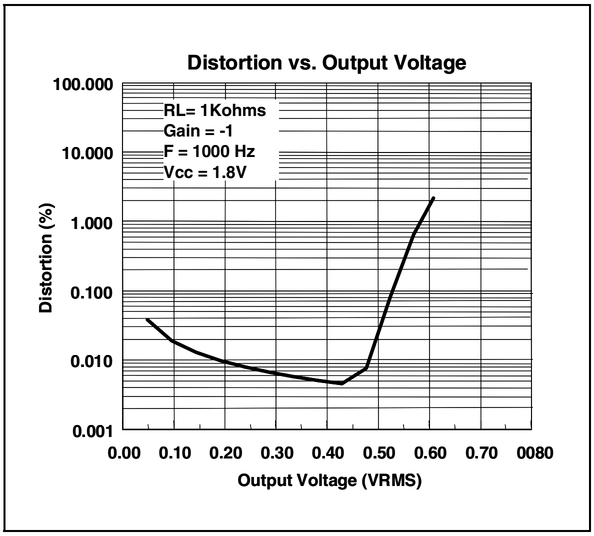


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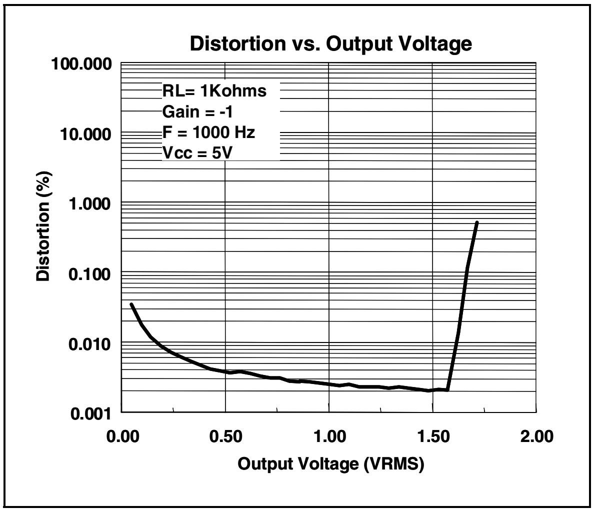


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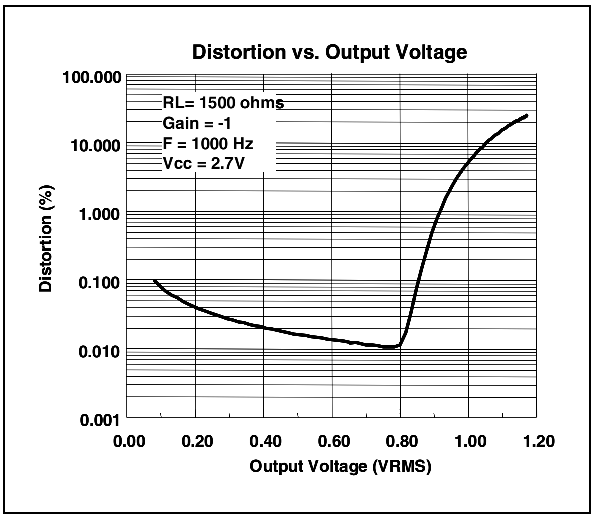


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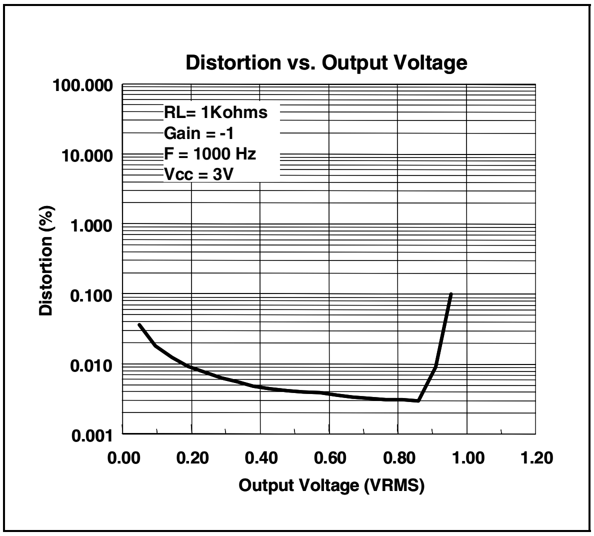


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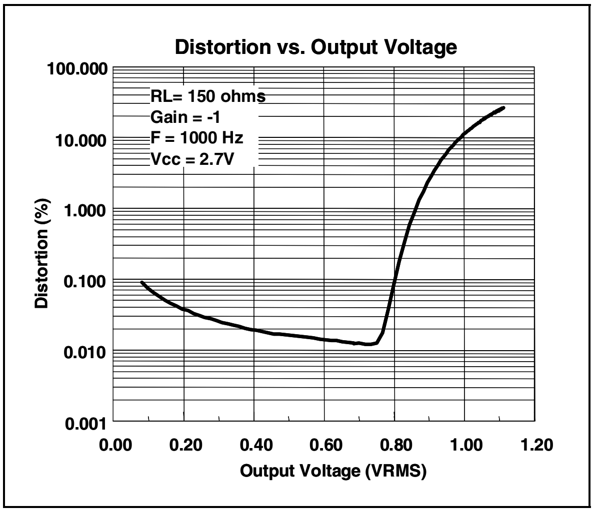


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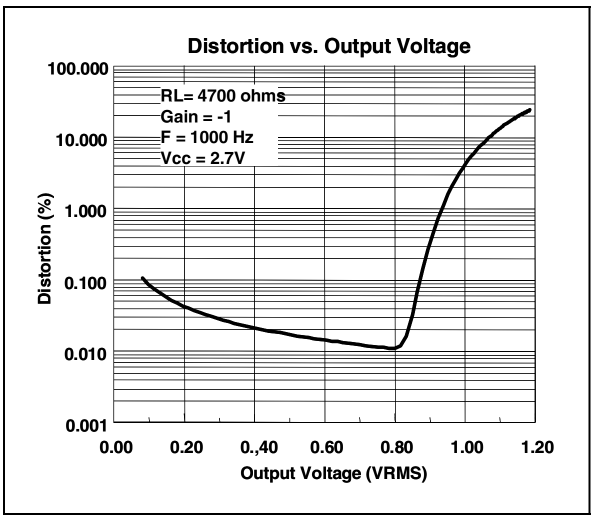


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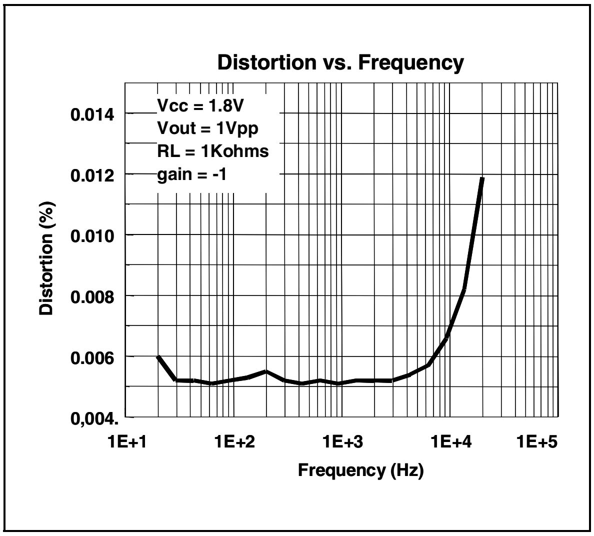


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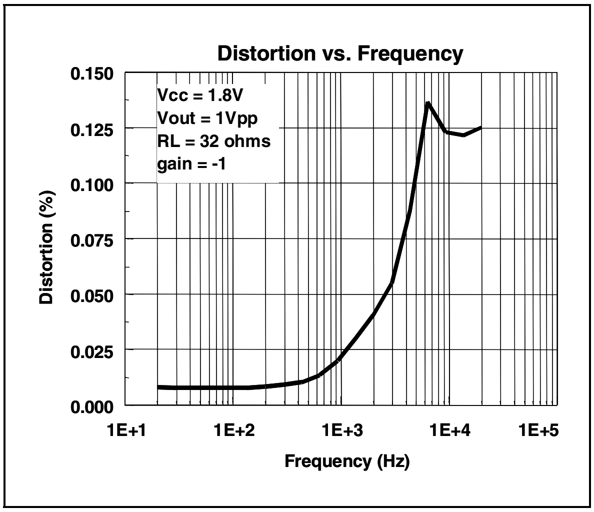


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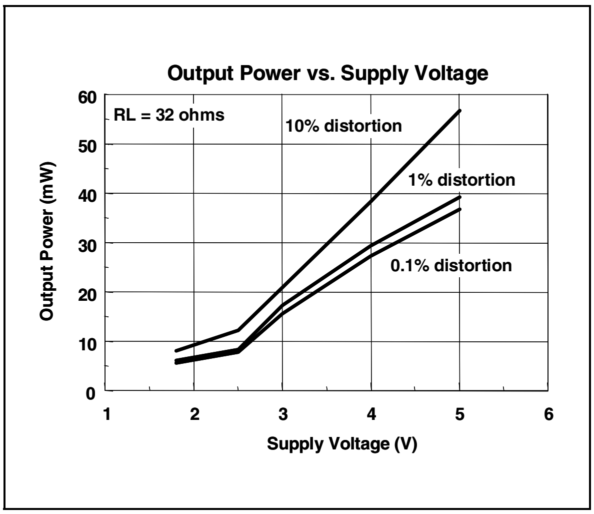


Figure 46 :

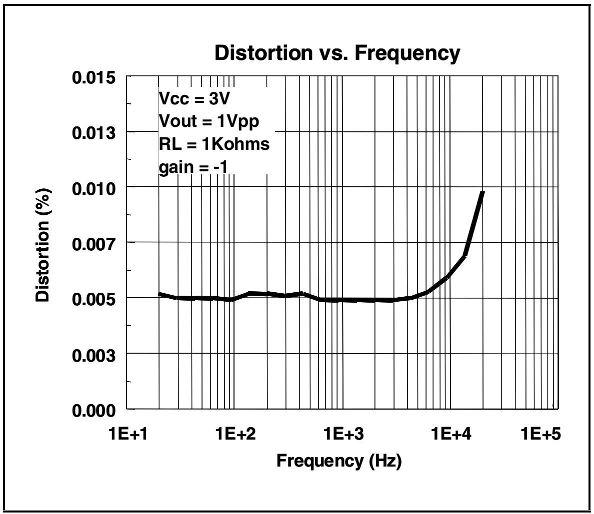
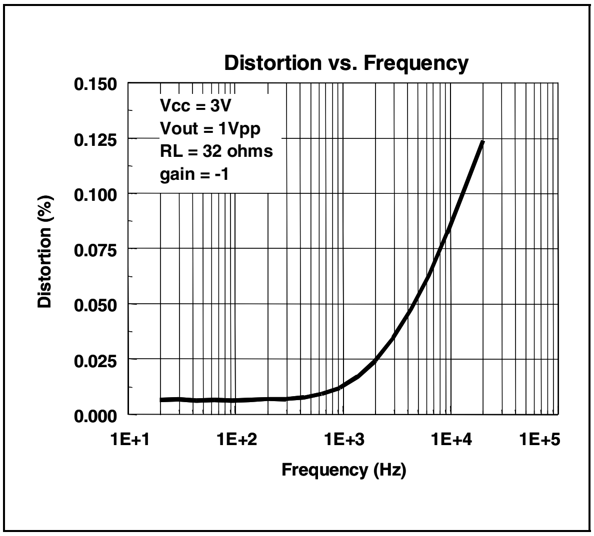


Figure 47 :

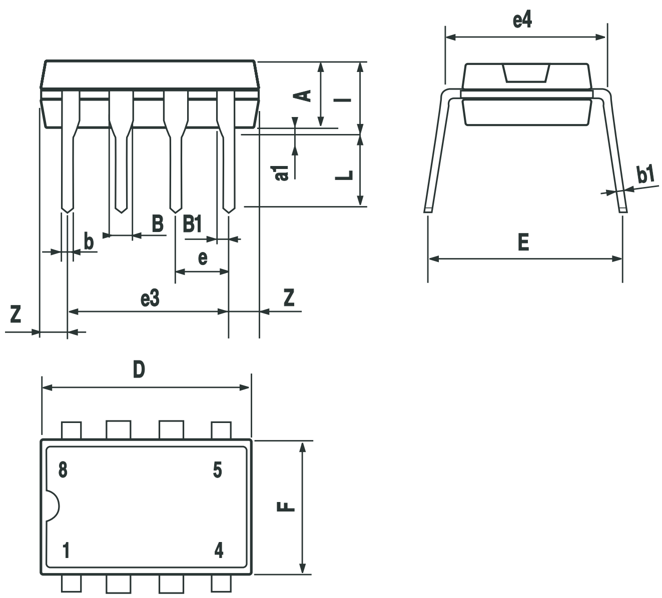


3 Package Mechanical Data

3.1 DIP8 package

Plastic DIP-8 MECHANICAL DATA

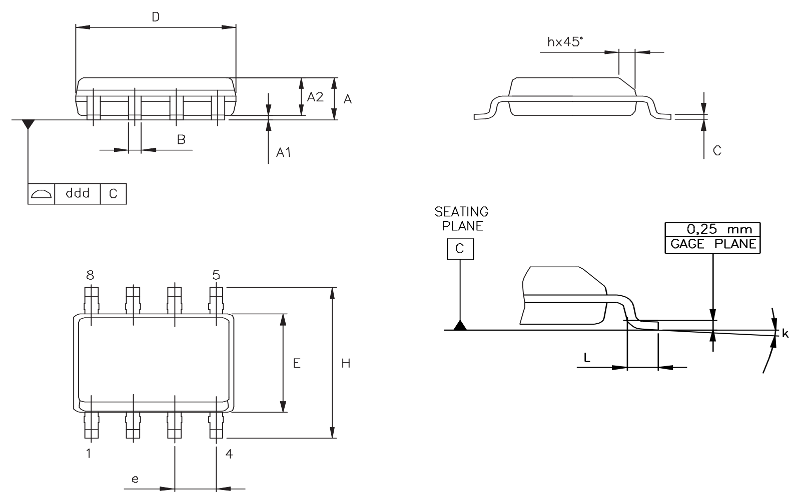
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A		3.3			0.130	
a1	0.7			0.028		
B	1.39		1.65	0.055		0.065
B1	0.91		1.04	0.036		0.041
b		0.5			0.020	
b1	0.38		0.5	0.015		0.020
D			9.8			0.386
E		8.8			0.346	
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			7.1			0.280
I			4.8			0.189
L		3.3			0.130	
Z	0.44		1.6	0.017		0.063



P001F

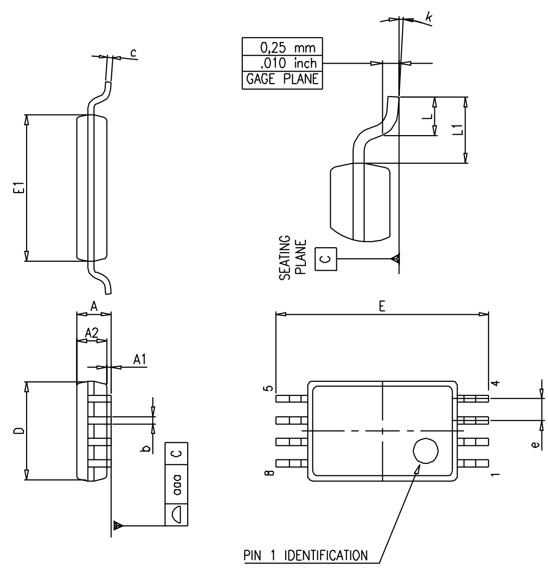
3.2 SO8 package

SO-8 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	8° (max.)					
ddd			0.1			0.04



3.3 TSSOP8 package

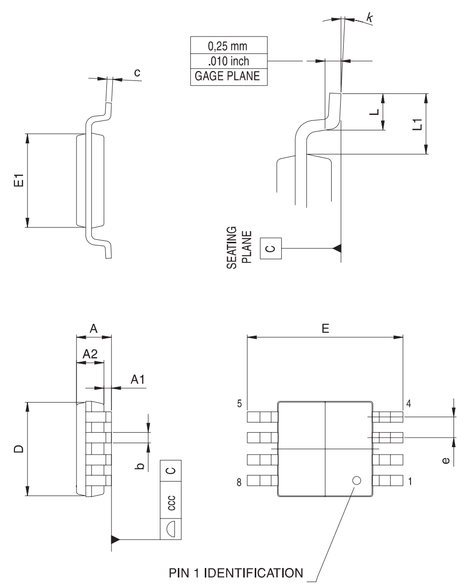
TSSOP8 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.008
D	2.90	3.00	3.10	0.114	0.118	0.122
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.0256	
K	0˚		8˚	0˚		8˚
L	0.45	0.60	0.75	0.018	0.024	0.030
L1		1			0.039	



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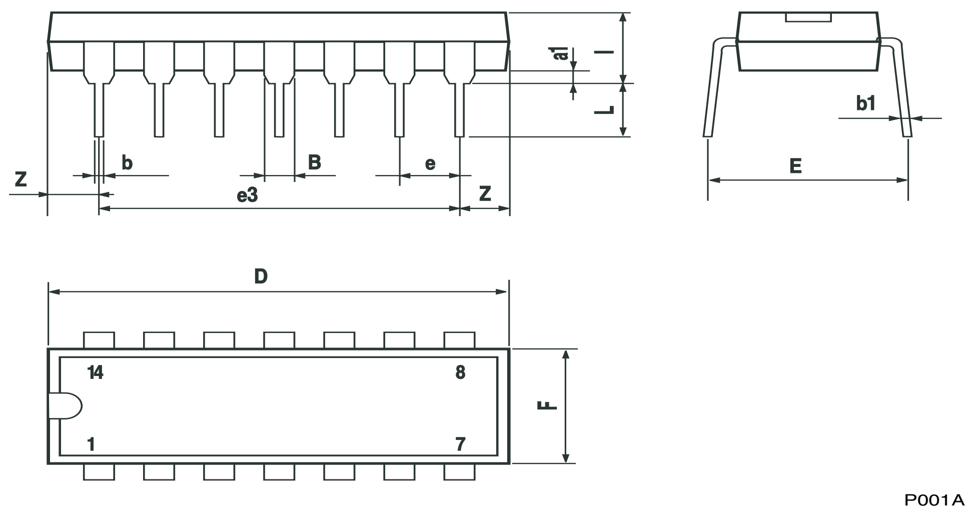
3.4 Mini SO8 package

miniSO-8 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.1			0.043
A1	0.05	0.10	0.15	0.002	0.004	0.006
A2	0.78	0.86	0.94	0.031	0.031	0.037
b	0.25	0.33	0.40	0.010	0.13	0.013
c	0.13	0.18	0.23	0.005	0.007	0.009
D	2.90	3.00	3.10	0.114	0.118	0.122
E	4.75	4.90	5.05	0.187	0.193	0.199
E1	2.90	3.00	3.10	.0114	0.118	0.122
e		0.65			0.026	
K	0°		6°	0°		6°
L	0.40	0.55	0.70	0.016	0.022	0.028
L1			0.10			0.004



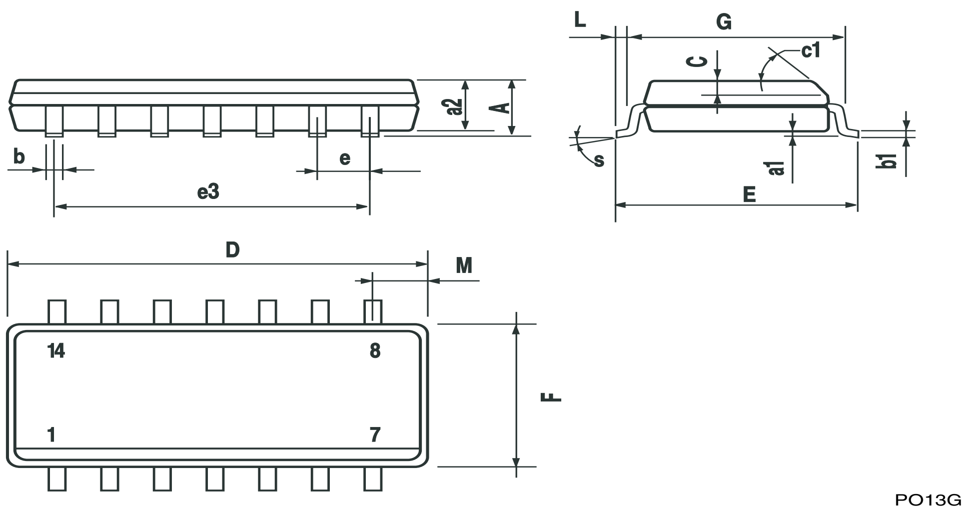
3.5 DIP14 package

Plastic DIP-14 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



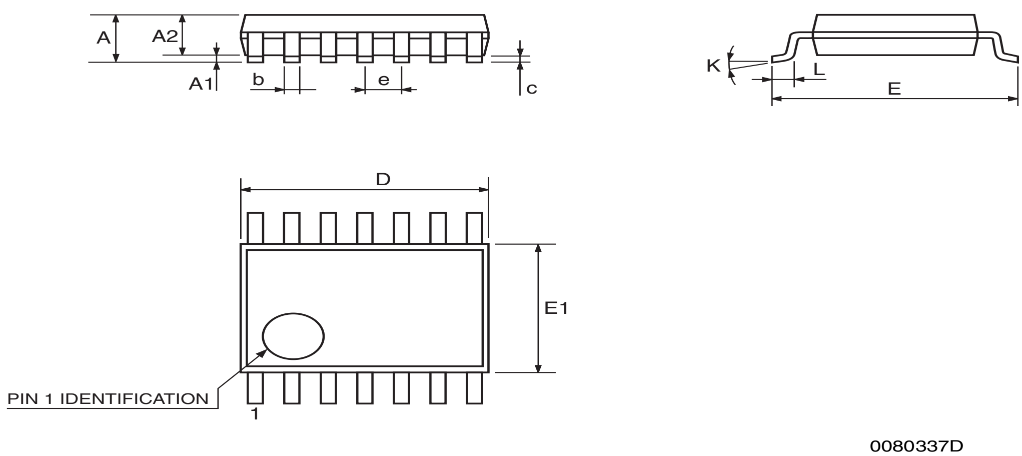
3.6 SO14 package

SO-14 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.68			0.026
S	8° (max.)					



3.7 TSSOP14 package

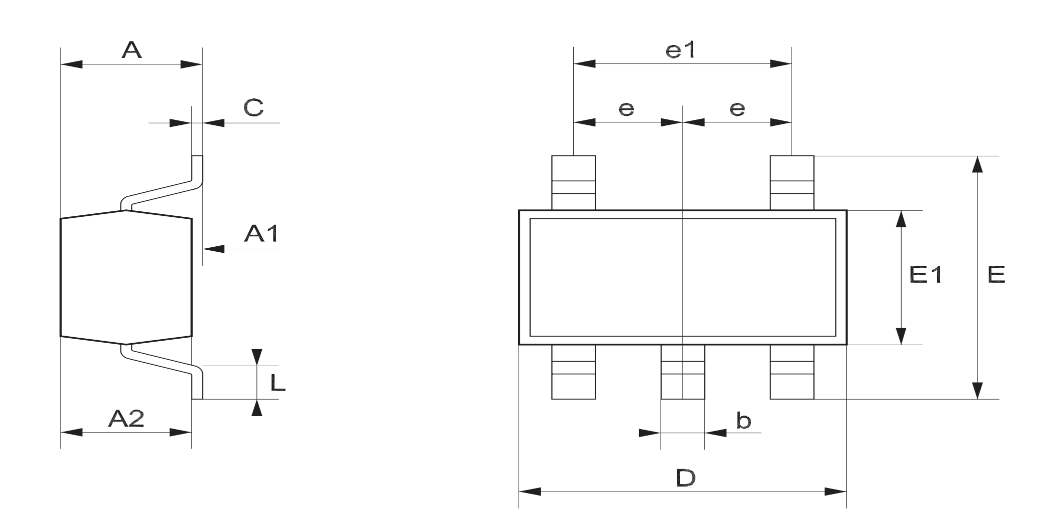
TSSOP14 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



3.8 SOT23-5 package

SOT23-5L MECHANICAL DATA

DIM.	mm.			mils		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	0.90		1.45	35.4		57.1
A1	0.00		0.15	0.0		5.9
A2	0.90		1.30	35.4		51.2
b	0.35		0.50	13.7		19.7
C	0.09		0.20	3.5		7.8
D	2.80		3.00	110.2		118.1
E	2.60		3.00	102.3		118.1
E1	1.50		1.75	59.0		68.8
e		0 .95			37.4	
e1		1.9			74.8	
L	0.35		0.55	13.7		21.6



4 Revision History

Date	Revision	Description of Changes
01 April 2002	1	First Release
01 Jan. 2005	2	Modifications on AMR *Table 1 on page 2* (explanation of Vid and Vi limits)